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**400 SERIES SPRAY GUNS &  
400 SERIES CONTROL UNIT**

*INSTRUCTION MANUAL*



<b>DOCUMENT:</b>	<b>400 Guns &amp; 400 GCU - Manual</b>
<b>DATE ISSUED:</b>	
<b>ISSUE NUMBER:</b>	<b>1</b>



# **CAUTION**

**This equipment can be dangerous unless it is used in accordance with the rules laid down in this manual.**

**Read this manual completely before installing and operating the equipment, and keep on file.**

**Ensure all safety instructions and procedures are correctly followed and that all operators are fully trained.**

**This equipment must be installed and used in accordance with all relevant local and national safety codes and standards.**

**In countries of the EEC, refer also to EN1953:1999 and the ATEX Directive 94/9/EEC. For Manual Powder Spray Installations refer also to EN50053: Part 2:1989 and for Automatic Powder Spray Installations refer also to EN50177:1997.**

**DO NOT permit untrained or unauthorised personnel to maintain or adjust this equipment.**

**All other manuals relevant to components and equipment of the installation must be followed.**

- 1. Ensure that the equipment is properly earthed/grounded. Refer to assembly instructions.**
- 2. The electrical supply to the gun's electrostatic generator and the control unit must be interlocked with the spray booth extraction system such that spraying cannot be carried out unless the exhaust ventilation system is in operation. The efficiency of the exhaust ventilation system should be checked regularly.**
- 3. All conductive structures within the vicinity of the spray area shall be bonded together with the earth terminal of the high voltage generator to the protective earth of the system electrical supply.**
- 4. The equipment operates by electrostatically charging the powder by means of a high voltage corona discharge at the nozzle of the spray gun. This electrostatic discharge can seriously damage other electronic equipment if it is sited in close proximity and not suitably protected.**
- 5. It is essential that all jigs and work pieces are adequately earthed. The workpiece shall have a resistance to earth of no greater than 1 Mohm. This should be checked regularly. If the earthing is not adequate, this can result in:-**
  - a) Poor coating.**
  - b) Sparks between the product and jigs, which can constitute an ignition or explosion hazard.**
  - c) Radio and TV interference from sparks between the product and jigs. This interference may also affect computer systems and process controllers.**
- 6. Ensure the air supply is clean and dry.**

**NOTE:- Refer to pneumatic specifications.**



## **EC Declaration Of Conformity**

We, Exel Industrial UK Ltd. declare that the following product:

**Description:** i) Powder Coating Gun Control Unit  
ii) Manual Powder Coating Spray Gun  
iii) Automatic Powder Coating Spray Gun

**Model:** i) GCU400  
ii) MG400  
iii) AG400

**Use:** Electrostatic Powder Coating Gun Control Unit to be used in conjunction with the powder coating spray guns MG400-Manual type or AG400-Automatic type.

was manufactured by ourselves and conforms with the following standard (s) and / or other normative document (s):

EC Machinery Directive 89/392/EEC  
EC Low Voltage Directive 73/23/EEC  
EC Directive of Electromagnetic Compatibility 89/336/EEC  
Electrostatic Painting and Finishing Equipment Using Flammable Materials  
EN50 050:2001 and EN50 053:Part 2:1989

Signed on behalf of Exel Industrial UK Ltd. by



Mr. D.H. Campbell  
Technical Manager

### **EXEL Industrial UK LTD**

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## **400 SERIES SPRAY GUNS & 400 SERIES CONTROL UNIT**

### **TOTAL ENERGY CONTROL (TEC)**

The 400 series powder coating spray guns utilise the "Total Energy Control" system developed by Exel. Once the maximum energy level has been set the "Total Energy Control" system automatically adjusts both the current and voltage enabling the operator to gain optimum spraying results. Defects caused by back ionisation and the faraday cage effect etc. are minimised.

### **SPRAY GUNS**

<b>MANUAL</b>	Type MG 400	<b>AUTOMATIC</b>	Type AG 400
<b>SPRAY GUN</b>	Part No. 3019002	<b>SPRAY GUN</b>	Part No. 3022002

The Exel MG 400 and AG 400 spray guns are built to a robust and compact design utilising a high efficiency corona discharge to charge the powder coating material.

Both guns incorporate a high voltage multiplier charging system which converts the governed low voltage dc. power supply received from Exel's 400 Series Gun Control Unit to a maximum output voltage of 85kV and a maximum output current of either 50uA (mode 1) or 100uA (mode 2) at the single point corona needle.

The gun nozzle may be fitted with a variety of powder deflectors and slotted caps which, combined with a forward air supply to the nozzle, enable the operator to control the spray pattern to suit the components being sprayed. A variety of nozzle adapters are available separately including extended nozzles and a cup attachment.

Both guns are manufactured with a minimum number of components and feature several mouldings offering greater reliability and ease of servicing. To this end the gun services may be disconnected within seconds.

The power connection to the gun is via a screened highly flexible cable.

The MG 400 Manual Powder Coating Spray Gun has been ergonomically designed to be well balanced, light weight and comfortable with a contoured grip.

The AG 400 Automatic Powder Coating Spray Gun may be mounted on a swivelling clamp at the end of a support arm allowing the maximum flexibility of gun position and angle with respect to the workpiece. The gun and support bar may be carried on gun manipulators such as a Reciprocator or a Swinger TM, or fitted to fixed gun mountings.

### **GUN CONTROL UNIT**

#### **Type GCU400, Part No. 2024002**

The Gun Control Unit provides all the control functions necessary to spray and charge powder using the Exel 400 Series of manual and automatic powder coating spray guns.

It contains the control P.C.B. which provides a governed low voltage d.c. power supply to the spray gun. The operator may set the spray gun output to a maximum output voltage of 85kV and a maximum output current of either 50uA (mode 1) or 100uA (mode 2) using the control unit. The set value of kV (mode 1) or uA (mode 2) is displayed on a numerical led display.

Separate led bar graph displays enable the operator to monitor the electrostatic charge supplied to the gun either in terms of the voltage or current. When used with manual guns the electrostatics may be turned off to enable powder emissions to be set without charging the powder.

The unit has 3 regulated pneumatic outlets, the pressure regulators and gauges being mounted on the front panel. Two of these supply air to the venturi powder air and

dilution air ports for pumping and controlling the supply of powder fed to the gun. The third is used to supply air to the nozzle of the spray gun.

Led indicators on the front panel show whether the unit is set for use with manual or automatic guns and it's also the unit is operating in mode 1 (TEC 1) or mode 2 (TEC 2).

The mains electrical supply to the unit is provided via. a sealed connector.

A non-switched electrical outlet is provided to enable the electrical supply to be linked through to other units, for example when situated in an automatic system console or double operator manual units.

Circuit protection is by means of miniature circuit breakers.

The unit is mounted by means of 2 x M6 screws in each side, and on the rear panel.

## SPECIFICATION

### GCU400

#### Electrical Data

<b>Input Voltage</b>	100-240 Volts 50 / 60 Hz single phase
<b>Power Consumption (full load)</b>	45 VA
<b>Input Current (max.)</b>	400 mA at 115 V 200 mA at 230 V
<b>Electrostatic output voltage (max.)</b>	10 - 85 kV negative.
<b>Electrostatic output current</b>	Mode 1; 0 - 50 uA      Mode 2; 0 – 100 uA.

#### Electrical Controls

<b>Mains Switch- Front Panel</b>	Rotary 3 position-	OFF/ON/REMOTE (AUTO) OFF/ON/E'STATICS OFF(MANUAL)
<b>Mode Selection Front Panel</b>	Push Button LED's display mode selected	TEC 1 (mode 1)/ TEC 2 (mode 2)
<b>Charge Control- Front Panel</b>	Push Buttons +/- to increase or decrease	Sets the maximum level of kV(Mode1). Sets the maximum level of uA(Mode2).
<b>Set Value Display Front Panel</b>	Numerical LED Indicator	Displays set max. kV. (Mode1) TEC1 Displays set max. uA. (Mode2) TEC2
<b>Electrostatic Charge Indicators Front Panel</b>	LED Bar Graphs	0 to 100 µA / 0 to 100 kV

**Auto-Manual Selection -- Unit automatically detects which type of gun is connected**

*Auto gun connected*  
LED displays "A"  
Auto selected  
LED Indicator at "A"

Unit triggers automatically when main switch is turned to **On** position. (1)

Unit triggers via remote 24V dc. supply when main switch is turned to **Remote** position. 

*Manual gun connected*

Unit is triggered  by micro-switch in Hand Gun or other remote triggering device when

LED Indicator at “T” when triggered  
 main switch is turned to **On** position.(1)  
 Unit is triggered by micro-switch in Hand Gun or other remote triggering device without electrostatics when main switch is turned to **E’s statics Off** position.

**Mains Input** Via connector on rear panel.  
**Mains Output Socket** Non switched 6A max.- may be used to connect additional control units.  
**Trigger Switch - Hand Gun** Microswitch in hand gun- connected through plug and socket on rear of control unit.  
**Remote Trigger -** 24 V dc. Supply from Remote PLC. connected through plug and socket on rear of control unit.

**Circuit Protection**

Miniature circuit breakers:- *Mains input* - 0.6A  
*Mains output* - 6A

**Pneumatic Data**

**Input air pressure** 7.0 bar (100 p.s.i.) max.  
**Input air conditioning** Oil free to 0.1 p.p.m. and dry to 1.3 g/cubic Nm.  
**Air consumption** 400H 10.0 cubic m/h. ( 6.0 c.f.m. ) F Bed Unit  
 (Nominal) 400D 15.0 cubic m/h. ( 9.0 c.f.m. ) Box Feed Unit  
 400A 10.0 cubic m/h. ( 6.0 c.f.m. ) Auto Unit  
**Input Connection** 8mm. OD tube air fitting.

**Pneumatic Controls**

**Pressure regulators and gauges**

These control the air supply pressure to the following :-

- i) Powder delivery 4 bar (60 psi) **venturi jet**; controls delivery of powder from the venturi to the gun.
- ii) Dilution ratio 2 bar (30 psi) **venturi dilution**; controls mixture ratio of powder to air from venturi to gun.
- iii) Gun-Forward air 2 bar (30 psi) **air supply to gun**, prevents powder build up on face of deflectors and inside nozzle.

**Auxiliary output**

Maintained unregulated output for connection of ancillary equipment, eg. Second control unit or an air clean down gun. Connection 6mm. push in fitting. Supplied fitted with blanking plug.

**Weights & Dimensions**

Complete Unit weight/dims.  
 Packed Unit weight/dims. 40 kg. 72cm x 51 cm x 106 cm

**Gun Control Unit GCU400**

Nett Weight:- 8.0 kg  
 Nett Dimensions:- 280 mm x 280 mm x 120 mm

**Manual Gun MG 400 -** Weight:- 0.495 kg  
 Dimensions:- 330 mm x 200 mm x 45 mm

**ASSEMBLY INSTRUCTIONS**

## WARNING: THIS EQUIPMENT MUST BE EARTHED

**NOTE:-** Electrical and pneumatic circuit diagrams are given at the rear of this manual.

1. Carefully remove units and components from packaging, and check contents against packing list.
2. Mount the Gun Control Unit in a secure manner and positioned at least 0.5m away from any spray booth opening.
3. Connect the airlines to the outlet ports of the rear panel of the Gun Control Unit as follows:- (Refer to the rear panel illustration and key to symbols).
  - a) RED airline from Venturi Jet to the 'Powder Delivery Air Supply Output'.
  - b) BLUE airline from Venturi Dilution Port to the 'Powder Dilution Air Supply Output'.
  - c) BLACK airline from the Guns to the 'Gun Air Supply Output'.

**Fluid Bed** units, connect the CLEAR air line from the fluid bed regulator (mounted on the side of the chassis) to the 'Fluid Bed Air Supply Output' at the bottom right hand corner of the control unit.

**Box Feed** units, connect the CLEAR airlines from the vibration control regulator and the Fluidising Pad (which are joined with a "T" connector) to the 'Vibrating Box Air Supply Output' at the top right hand corner of the control unit.

**NOTE:-** The Venturi Jet is identified by a Red washer & the Dilution Port by a Blue washer.

4. Release the dust cover from the 'Gun Supply and Trigger' connector on the rear panel. Plug in and secure the gun cable using the latch provided.
5. Connect a suitable airline to the main incoming air fitting, 'Mains Air Supply In'
6. Connect the mains electrical supply to the main electrical input connector.

### IMPORTANT

*When fitting a suitable plug to the mains lead, it is essential that it contains an earthing / grounding contact and that this is connected.*

*Under no circumstances should this equipment be connected to a mains supply which does not include an earthing / grounding wire and contacts. e.g.. 2 -Wire extension leads as used for some domestic equipment **MUST NOT BE USED.***

**NOTE:-** The colour coding for mains wires are:-

		<b>U.K.</b>	<b>U.S.A.</b>
Live	<b>L</b>	Brown	Black
Neutral	<b>N</b>	Blue	White
Earth / Ground	<b>E</b>	Green / Yellow	Green

**NOTE:-** The terminals used in the mains connectors on the rear panel of the unit are:-

Live	Pin 1
Neutral	Pin 3
Earth / Ground	Pin E

**For United Kingdom Installations**

If the colours of the mains lead of this appliance do not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:-

The GREEN and YELLOW wire must be connected to the terminal in the plug which is marked with the letter "E" or by the earth symbol, or coloured green or green/yellow.

The BLUE wire must be connected to the terminal which is marked with the letter "N" or coloured black.

The BROWN wire must be connected to the terminal which is marked with the letter "L" or coloured red.

**NOTE:-** The method of disconnection from the mains electrical supply shall be by removal of the plug on the mains lead from its respective supply socket.

**NOTE:-** If the system is intended to be permanently connected to mains wiring then the switch used to disconnect the unit from the supply voltage must disconnect all poles and have a contact separation of at least 3mm.

***The unit is now ready for use***

## **INSTALLATION AND OPERATING INSTRUCTIONS**

**Ensure that the unit has been correctly assembled.**

**NOTE:-** Full electrical and pneumatic circuit diagrams are given at the rear of this manual.

**NOTE:-** See pneumatic specification for control functions.

1. Ensure that all switches are in the OFF position and that all pressure regulators are closed (The knobs should be turned fully anticlockwise). The knobs of the pressure regulators are released by pulling upwards and locked by pressing inwards.
2. If a fluidised bed is being used, this should be fully fluidised prior to spraying.
3. With the spray gun pointing into an extracted spray booth, turn the main electrical switch to the “**On**” position.(1)  
When used with automatic spray guns the mains electrical switch will also trigger the electrostatic generator and air supplies.  
Open the left hand regulator to approx. 5 psi to supply air to the gun nozzle.  
For a manual gun, operate the gun trigger to energise the electrostatic generator and air supplies.  
Open the centre regulator (dilution air) to approximately 5-10 psi. and then open the right hand regulator (powder) to give the required powder output. It is good practice always to operate the "Powder" regulator last in order to avoid any powder contamination of air lines. A good starting point is approximately 20 psi.
4. Having set the volume of powder required from the gun, there may be a tendency for the powder flow to surge unduly, this can normally be eliminated by adjusting the dilution air pressure.

With the gun pointing into an extracted spray booth, trigger the unit and slowly move the nozzle of the gun progressively closer to an earth point or the product. It will be seen that as the nozzle moves closer, the current will rise progressively to a maximum of 50uA in mode 1 (TEC 1) or 100 uA in mode 2 (TEC 2). As the nozzle continues to be moved closer, the discharge current and voltage then falls progressively to very low levels as the nozzle touches the earth.

**NOTE:-** Refer to the graph showing the typical electrostatic discharge characteristics with respect to the distance from earth.

**NOTE:-** The discharge current and voltage will be dependent on the proximity of the spray gun discharge needle to earth. When setting the maximum discharge voltage, the spray gun discharge needle should be placed at least 300 mm from earth.

### **GENERAL NOTE**

An approved mask must always be worn when spraying.

### **GENERAL OBSERVATIONS**

It is essential that all substrates and jigs are clean and that there is a good earth/ground to the workpiece to ensure maximum powder attraction.

Powder spraying is best performed by slow motions of the spray gun as opposed to the faster gun movements often associated with liquid paint spraying.

Higher powder emissions do not necessarily mean faster coating or better penetration into corners and recesses. In practice it can often cause the opposite effect and produce products with a poor finish.

Similarly, high electrostatic discharge currents or voltages do not necessarily mean faster or more efficient coating. Again, in practice, they can cause the opposite effect and produce products with a poor finish.



## DO's And DONT's

### **DO's**

1. Ensure that the equipment is operated by trained personnel only.
2. Ensure that the equipment is serviced regularly by qualified personnel. All repairs and maintenance shall be carried out by qualified personnel only, in accordance with the manufacturers instructions (failure to observe may result in the invalidation of any warranty on the equipment).  
Repairs must be carried out at the instigation of the operator when faults or defects are detected. Repairs must not be performed in hazardous areas and must not compromise safety standards.
3. Ensure that the operator is correctly earthed. If overalls are worn, they should be anti-static or non-insulating. If gloves are worn, they should be anti-static or non-insulating. If this is not possible, gloves with the palms removed may be used. Footwear intended for use by operators shall be anti-static or non-insulating and shall comply with the requirements of ISO 2251 / BS 5451 or equivalent. Shoes with leather soles are usually adequate.
4. Ensure that the operator wears suitable respiratory equipment and or protective clothing. All personnel working in a powder-laden atmosphere should wear similar equipment.
5. Ensure that the operator wears suitable eye protection e.g. goggles or visor (in addition to a respiratory mask) when using a compressed air clean down gun as particles in the airstream can damage eyes.
6. Avoid skin contact with powders where possible as some powders may cause skin irritation.
7. Wash hands and face after work and prior to eating or drinking.
8. Keep floors and equipment within 5 metres of the spray area clean using a suitable industrial vacuum cleaner.
9. Keep light fittings and all other electrical equipment clean.
10. Regularly check the effectiveness of dust/powder extraction filters and that recycled air is clean.
11. Regularly check the earthing of electrical equipment and manually operated spray guns.
12. Regularly check the earth bonding of all conductive electrical enclosures and all conductive structures such as floors, walls, ceilings, fences, conveyors, powder containers etc. within the vicinity of the spray area. These shall be bonded together with the earth terminal of the high voltage generator to the protective earth system of the electrical supply. Electrostatic grounding should comply with EN 50053.
13. Ensure that all jigs and work pieces are adequately earthed. Each workpiece shall have a resistance to earth of not greater than 1 Mohm. This resistance shall be checked regularly.
14. Ensure that correct cleaning procedures are followed. See "Shut down and cleaning procedures".
15. Ensure that powders are processed in compliance with the powder manufacturers instructions. Special care should be taken with powders containing metallic pigments.

**NOTE:-** The workplace must be kept tidy and well organized to reduce the risk of accidents. Good illumination, protection from any damp environment and correct storage of materials will assist the operator to maintain concentration and an awareness of potential hazards.

**NOTE:-** Before starting to clean the spray gun or carrying out any other work in the spraying area, the high voltage supply shall be switched off in such a manner that it cannot be re-energized by operating the trigger of the spray gun.

## **DONT's**

1. The operator must not wear insulating gloves, clothing or footwear.
2. Do not smoke in areas where powder coating is being carried out or in areas where powder is stored.
3. Do not eat or drink in areas where powder coating is being carried out or in dust-laden atmospheres.
4. Do not spray into areas which are not properly extracted. The direction of airflow should always be from behind the operator. It is recommended that airflow velocities over the face area of a booth opening should be in excess of 0.5 metre/sec.
5. Do not use compressed air for cleaning skin and clothing as it can penetrate the skin causing embolisms. Use a suitable industrial vacuum cleaner for clothing and wash skin with water.
6. Do not point compressed air clean down guns towards body orifices such as mouth, ears etc.
7. Do not enter spray booths when in operation.
8. Do not operate fluidized beds without connecting a suitable vent hose from its lid to an extracted area such as a spray booth.

## CHANGING COLOUR

In order to prevent contamination of the product from a previous colour, it is essential to remove all traces of the previously sprayed powder from the application equipment. i.e.. Powder container, suction tubes, Venturies, Powder hoses and Spray guns. Also any other surfaces where powder may become dislodged and cause contamination of the product or new powder. If the powder is to be reclaimed, then the spray booth, ductwork and recovery equipment must also be thoroughly cleaned.

**IMPORTANT**      *WHENEVER COMPRESSED AIR IS USED FOR CLEANING EQUIPMENT. THIS OPERATION MUST BE CARRIED OUT IN AN EXTRACTED SPRAYBOOTH.*

1. Turn the mains switch OFF, discharge the gun by touching the corona needle to a good earth and disconnect the mains supply.
2. Remove the venturi.
3. Remove the powder hose and airlines from the venturi.
4. Squeeze the oval clip at the top of the suction tube and remove the suction tube from the venturi mounting spigot. Remove any excess powder from the venturi mounting bracket (box feed) or fluid bed lid.
5. Using clean, dry compressed air from a blow gun, blow through the suction tube and wipe clean the outside.
6. Remove the powder box or clean the fluid bed.
7. Remove the powder tail fitting complete with the PTFE insert from the venturi body and blow them clean.
8. Blow through the venturi body and clean the outside then refit the hose tail and insert. **ALWAYS CHECK THE CONDITION OF THE PTFE INSERT FOR SIGNS OF EXCESSIVE WEAR AND REPLACE AS NECESSARY.**
9. Remove the powder hose from the gun and purge the inside of the hose with compressed air from both ends ensuring that the discharge end is pointing into an extracted spray booth.
10. Remove the nozzle from the gun and clean internally and externally with compressed air. Clean the gun in the same way.
11. Refit the nozzle and powder hose to the gun.
12. Replace the suction tube into the venturi mounting spigot such that it clips into place and is retained by the oval clip.
13. Re-connect the powder hose to the venturi, and the airlines i.e. red airline to fitting with red washer and blue airline to fitting with blue washer, then clip the venturi back on to the spigot.
14. Clean off any excess powder or contamination from chassis (manual units).

### **FAULT FINDING**

<b>UNIT WILL NOT OPERATE (No LED's will illuminate)</b>	Check that mains connector is fitted to rear panel of control unit.
	Check that unit is connected to a suitable mains electrical supply and is switched on. (The electrical supply should be interlocked with the booth extraction system.)
	Check that miniature circuit breaker (automatic fuses) on the rear panel of the control unit have not been tripped. If one or more has, then press to reset. If it trips again, switch off unit and refer to an authorized distributor or service agent.
<b>UNIT WILL NOT OPERATE (LED's will illuminate)</b>	Check the gun trigger connection on the rear panel of the control unit is correctly fitted.
	Check the gun trigger connection on the bottom of the gun handle is correctly fitted.
	Check that the trigger switch in the gun is operating. Depress the trigger and an audible click should be heard if the trigger switch is operating. LED at "T"
<b>NO POWDER DELIVERY</b>	Check air supply to unit.
	Check that the powder container is not empty.
	Check that the powder in the powder container has no rat holes or voids around the suction or induction point - increase fluidization/vibration or agitate powder cup.
	Check that powder is not damp.
	Check for kinked or blocked powder hose.
	Check for blockage in suction tube, venturi body and gun.
<b>POWDER DELIVERY INTERMITTENT OR SURGING</b>	Check ratio of dilution air to powder air and adjust if necessary.
	Check for any kinks or partial blockages in the powder hose, venturi suction tube and body, or gun.
	Check that the venturi body is seating firmly on the mounting spigot and that the O-rings are not damaged.
	Check condition of the PTFE insert in the venturi for signs of wear- replace as necessary.
	Check that there is sufficient powder in the box.
	Check that the induction holes in the bottom of the suction tube are fully immersed in the powder.
<b>POWDER DOES NOT ADHERE TO WORKPIECE</b>	Manual guns:- Check that main switch is set to I (on) and not the second position which turns off the electrostatics.
	Check the that setting of the charge control (kV or uA) and that an electrostatic charge is present at the discharge electrode needle of the gun.
	If no charge (or very poor charge) is present, then check that there is no water present from the compressed air supply or from condensation.
	Check that the gun barrel is not contaminated with metallic particles from bright unbonded metallic powders.
	Check that the workpiece is properly earthed/grounded.

## DEFECTS ON FINISHED PRODUCT

<b>CONTAMINATION OF SURFACE WITH SPECKS OF OTHER COLOURS</b>	Application equipment inadequately cleaned after using previous powder.
	Airborne powder of different type within a contaminated spray booth, or sucked in from dirty surroundings.
	Reclaimed powder contaminated with other powders from within the reclaim system e.g. ductwork, cyclone, booth etc.
	Airborne contamination within the oven.
	Dust or dirt dislodged from jigs or conveyor.
	Dusty environment before or after coating.
<b>LUMPS OR PROTRUSIONS ON SURFACE</b>	Dirty or contaminated powder.
	Dirty or contaminated substrate (workpiece).
	Rusty substrate.
	Dusty environment before or after coating.
	Dust or dirt in oven.
	Dust or dirt dislodged from jigs or conveyor.
<b>HEAVY “ORANGE PEEL”</b>	Applied coating is too thick.
	Incorrect cure cycle and/or temperature.
	Inferior quality powder.
<b>FISH EYES</b>	Contamination of substrate.
	Contamination of powder.
	Contamination of compressed air supply eg. Silicone.
<b>CRATERS AND VOIDS</b>	Poor cleaning of substrate e.g. trapped oils or solvents.
	Wet components e.g. water trapped in corners or joints.
	Contamination of powder.
	Contamination of substrate.
<b>PIN-HOLING AND BUBBLES</b>	Porous substrate e.g. expansion or air or solvents from porosity or cavities in castings during curing cycle. Pre-heating of the workpiece may help
	Excessive electrostatic charge applied to the powder. To overcome, reduce the discharge voltage and/or increase the spraying distance.
	Rusty substrate.
	Contamination of substrate, powder, air supply or from dirty surroundings.
	Excessive moisture in compressed air supply. Refer to pneumatic data in specifications.

**NOTE:-** Contamination may be caused by airborne vapour such as wet paint, airline or conveyor oil or stripping facilities.

**NOTE:-** Silicones and acrylic paints are the worst offenders and can contaminate the powder and/or substrate.

## TOTAL ENERGY CONTROL

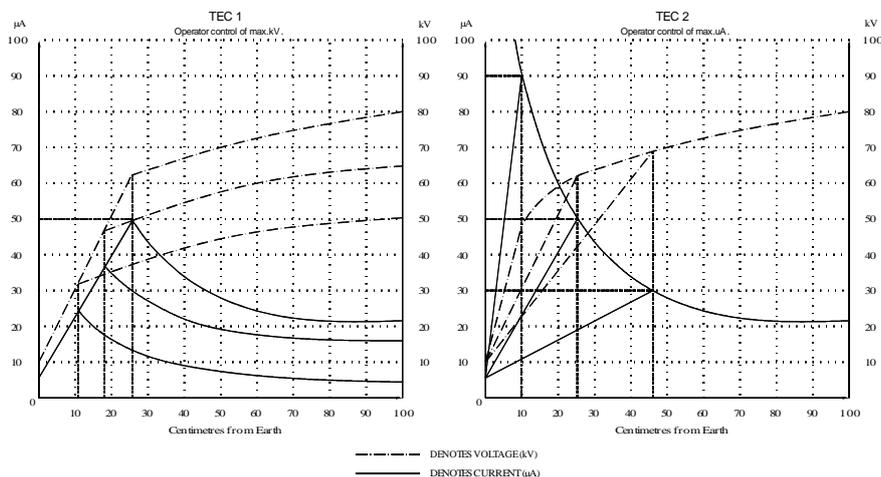
“Total Energy Control” is a patented system developed by EXEL INDUSTRIAL UK LTD. to automatically control the electrostatic charging energy of a spray gun to optimum levels of both current and voltage subject to the distance between the spray gun and the workpiece to be coated.

The spray material is not charged directly by the spray gun, but by the “charged air through which it passes between the spray gun and the workpiece. The charge density of the ionized air is a function of the discharge current from the gun. The smaller the distance between the gun and the workpiece, the smaller will be the volume of the air through which the powder travels, and the lower will be the discharge current required for the same charge density and vice versa. A reduction of discharge current is accompanied by a reduction in discharge voltage, resulting in a significantly lower discharge energy.

By automatically adjusting the total discharge energy in this way, the output is controlled from full discharge when away from the workpiece to minimal output when very close, but with the same high charging efficiency regardless of distance. A significant advantage of this technique is the ability to take the gun close in to a product to “place” the powder into hard to coat and Faraday Cage areas without the normal problems of overcharging the surface creating back ionization pinholes and orange peel, or blowing the powder off.

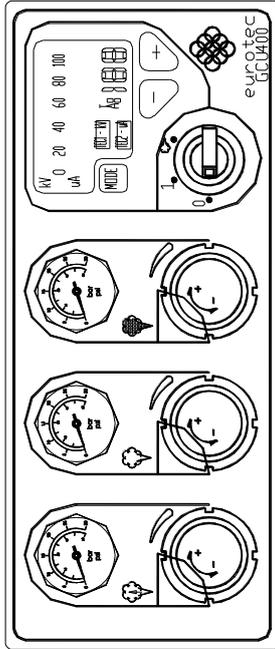
Total Energy Control is not new to Exel and is well proven and accepted for its coating benefits and ease of use. The original mode (TEC 1) with a 50 uA. threshold and operator adjustment of max. kV is suitable for the majority of standard powders and applications is now enhanced by a second operating mode (TEC 2). This gives the operator adjustment over the max. output current up to a 100 uA. threshold. This will help with the spraying of some of the more difficult metallic powders. Alternatively, if the discharge current threshold is turned down to say 30 uA. the active operating range of TEC may be increased to say 500mm. which may be very useful for automatic applications where products have large variations in their profiles.

When powering up a control unit, the last operating mode and settings will automatically be recalled. When switching between operating modes, the last settings of the alternative mode will automatically be recalled. Adjustment to max. kV. (TEC 1) or max. uA. (TEC 2) is made using the + and – buttons and the set value is indicated on the numerical display. The discharge voltage and current are indicated on the LED bar graphs.



## GCU-400 Gun Control Unit Front Panel Symbols Explanation

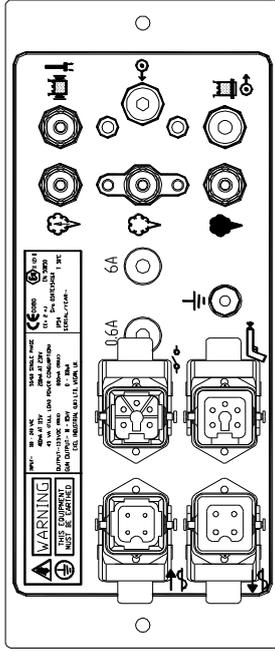
Illustration No. 6000197



- GUN AIR SUPPLY
- POWDER DILUTION AIR SUPPLY
- POWDER DELIVERY AIR SUPPLY
- UNIT OFF
- UNIT ON - POWDER & ELECTROSTATICS ON (AUTO GUN)  
- POWDER & ELECTROSTATICS ON WHEN GUN TRIGGER SWITCH OPERATED (MANUAL GUN)
- UNIT ON STANDBY FOR REMOTE OPERATION (AUTO GUN)  
UNIT ON WITHOUT ELECTROSTATICS WHEN GUN TRIGGER SWITCH OPERATED (MANUAL GUN)
- kV BAR GRAPH DISPLAY OF DISCHARGE KILO VOLTS
- uA BAR GRAPH DISPLAY OF DISCHARGE MICRO AMPS
- SET VALUE OF ELECTROSTATIC DISCHARGE - kV (TEC1) OR uA (TEC2)  
ILLUMINATED WHEN TOTAL ENERGY CONTROL MODE 1 SELECTED
- OPERATOR CONTROL OF kV  
ILLUMINATED WHEN TOTAL ENERGY CONTROL MODE 2 SELECTED
- OPERATOR CONTROL OF uA  
ILLUMINATED WHEN UNIT TRIGGERED BY MANUAL GUN OR REMOTE PLC
- ILLUMINATED WHEN AUTO GUN CONNECTED
- MODE PUSH BUTTON SELECTOR SWITCH FOR TEC 1 OR TEC 2
- PUSH BUTTON SWITCH TO REDUCE ELECTROSTATIC OUTPUT
- PUSH BUTTON SWITCH TO INCREASE ELECTROSTATIC OUTPUT

## GCU-400 Gun Control Unit Rear Panel Symbols Explanation

Illustration No. 6000198



- GUN AIR SUPPLY OUTLET
- POWDER DILUTION AIR SUPPLY OUTLET
- POWDER DELIVERY AIR SUPPLY OUTLET
- MAINS ELECTRICAL INPUT (ARROW POINTS TOWARDS CONNECTOR)
- MAINS ELECTRICAL OUTPUT (ARROW POINTS AWAY FROM CONNECTOR)
- ELECTRICAL OUTPUT TO GUN
- ELECTRICAL INPUT FROM REMOTE TRIGGER
- EARTH CONNECTION POINT
- 0.6A CIRCUIT BREAKER - GENERATOR SUPPLY
- 6A CIRCUIT BREAKER - SLAVE OUTPUT
- MAIN AIR SUPPLY IN (ARROW POINTS TOWARDS CONNECTION)
- FLUID BED / AUX AIR SUPPLY OUT  
(ARROW POINTS AWAY FROM CONNECTION)
- VIBRATOR / FLUIDISING PAD AIR SUPPLY OUT  
(ARROW POINTS AWAY FROM CONNECTION)

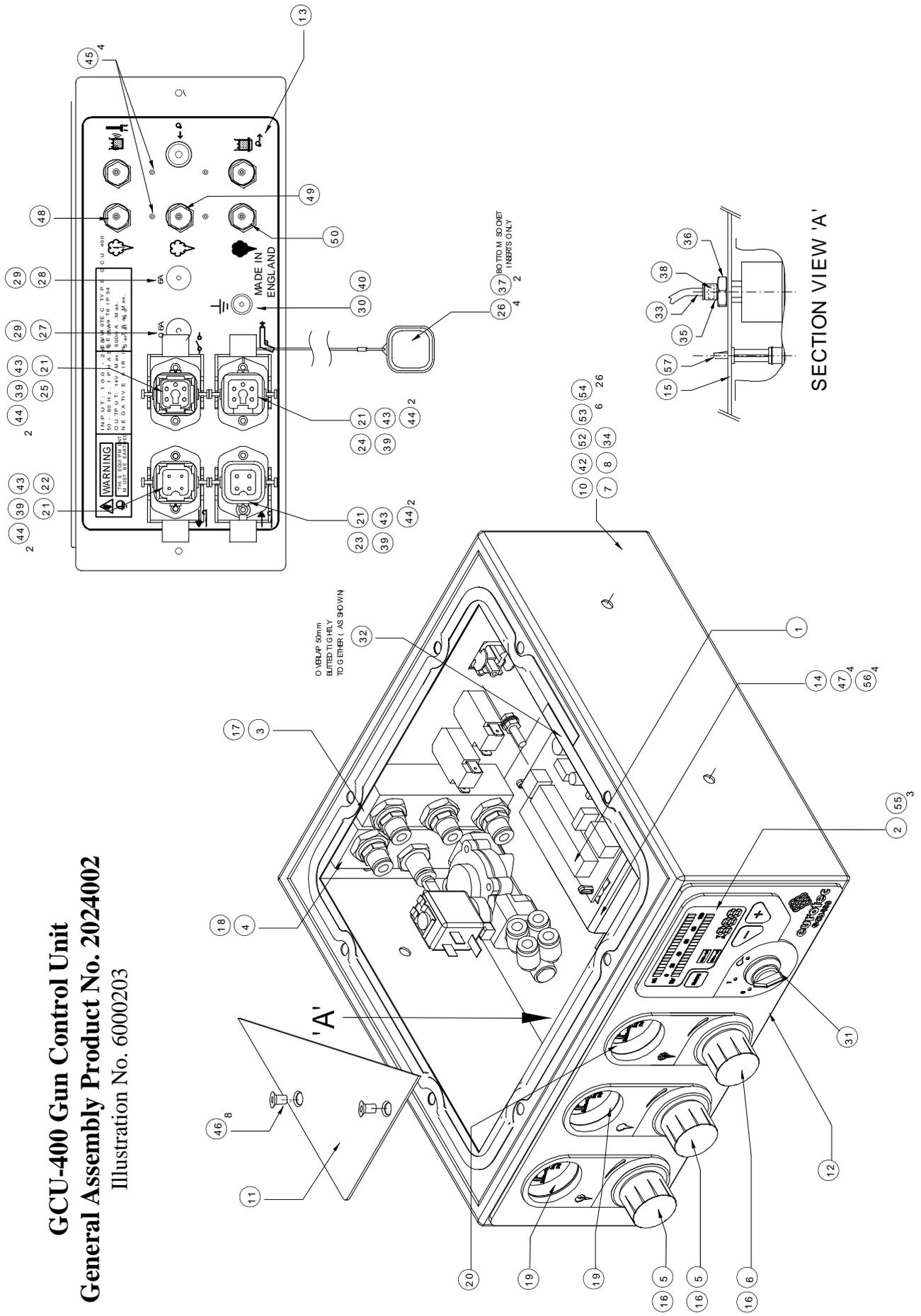


*APPENDIX (i)*

**ASSEMBLY DRAWINGS  
AND PARTS LISTS**



**GCU-400 Gun Control Unit**  
**General Assembly Product No. 2024002**  
 Illustration No. 6000203



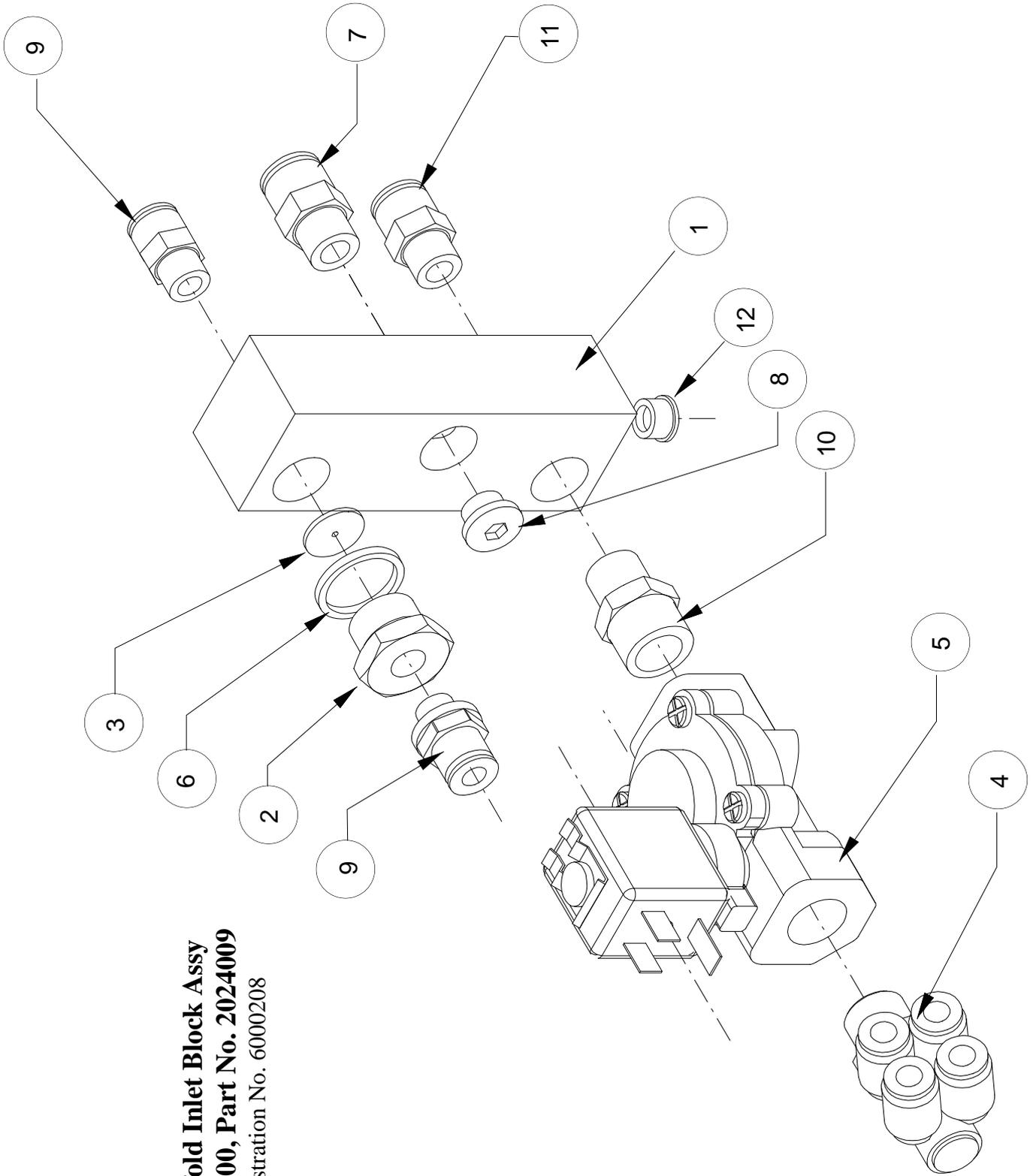
**GCU-400 Gun Control Unit General Assembly**  
*PARTS LIST*

<b>Item</b>	<b>Part No.</b>	<b>Description</b>	<b>Qty.</b>
1	2024006	Control PCB	1
2	2024005	Display PCB	1
3	2000007	Manifold, Outlet Block Assy	1
4	2024009	Manifold, Inlet Block Assy	1
5	2000026	Pressure Regulator Assy, 2 Bar	2
6	2010018	Pressure Regulator Assy, 4 Bar	1
7	2024007	Wiring Loom, Mains , GCU 400	1
8	2024008	Wiring Loom, Low Voltage	1
9			
10	2024010	Control Box Detail Type, GCU 400	1
11	2024011	Cover, GCU 400	1
12	2024012	Front Panel Overlay, GCU 400	1
13	2024013	Rear Panel Overlay, GCU 400	1
14	2024014	Chassis, 400 PSU/PCB	1
15	2024016	Gauge Support Plate	1
16	2024015	Spacer, Regulator	3
17	2020061	Gasket, Manifold Outlet	1
18	2020060	Gasket, Manifold Inlet	1
19	2024019	Pressure Gauge 30PSI/ 2 Bar	2
20	2024020	Pressure Gauge 60PSI/ 4 Bar	1
21	9000120	Connector Base, Panel Mounting	4
22	9000011	Connector Plug Insert, 3 pin + E	1
23	9000012	Connector Socket Insert, 3 pin + E	1
24	9000013	Connector Socket Insert, 4 pin + E	1
25	9000135	Connector Plug Insert, 4 Pin + E	1
26	9000014	Connector, Protective Cover	4
27	9000016A	0.6A Circuit Breaker	1
28	9000018A	6A Circuit Breaker	1
29	9000019A	Circuit Breaker Boot	2
30	9000021	Terminal, Earth Post	1
31	9001322	Switch, Rotary, 2 Pole, 3 Positions	1
32	9000063	Seal Strip, Foam,Self Adhesive,15mmx3mm	1M
33	9000203	Tubing, 4mmODx2.5mmID PU, Black	0.4M
34	9001843	Nylon Airline, 6mm	3M
35	9000052	Straight, 1/8BSPFP – 4mm OD Tube PI	3
36	9000806	Lock Nut, 1/8BSP Brass	3

***Continued:-***

<b>Item</b>	<b>Part No.</b>	<b>Description</b>	<b>Qty.</b>
37	2020059	Gasket, Connector Cover	2
38	5000040	Disc, Porous Plastic	6
39	9000832	Washer, M3, Crinkle	4
40	9000862	Washer, M5 Ext. S/P	1
41			
42	9000650	Screw, M6 x 8, Skt, Btn Hd, Black	4
43	9000501	Screw, M3 x 6, St. Stl, Pan Hd	4
44	9000500	Screw, M3 x 8, Skt, Cap, Black	8
45	9000551	Screw, M4 x 8, Skt, Btn Hd, Black	4
46	9000600	Screw, M5 x 6, Skt, Csk Hd, Black	8
47	9000801	Nut, M4 Nyloc	5
48	9000855	Washer, 1/8BSP, Nylon, Black	1
49	9000854	Washer, 1/8BSP, Nylon, Blue	1
50	9000853	Washer, 1/8BSP, Nylon, Red	1
51			
52	9000205	Label, Warning, Disconnect Mains	1
53	9000008	Cable Ties Base, Self Adhesive	6
54	9000022	Cable Ties, 2.5mm x 100mm	26
55	9001849	PCB Pillars, Display Board, 9.5mm	4
56	9001847	PCB Pillars, Control Unit, 6.4mm	4
57	9001848	PCB Pillars, Gauge Support Plate, 22.2mm	4



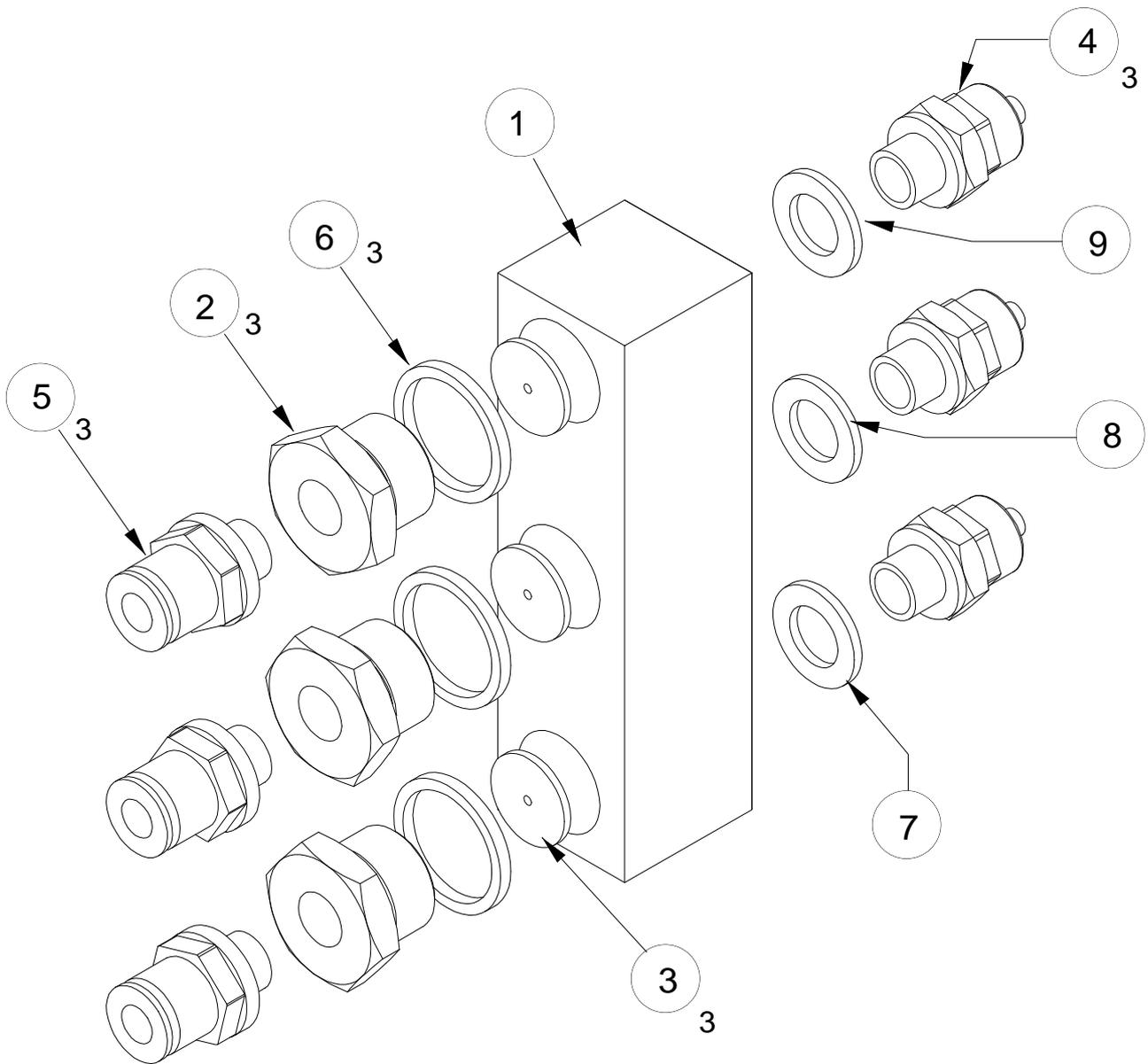


**Manifold Inlet Block Assy**  
**GCU-400, Part No. 2024009**  
 Illustration No. 6000208

**Manifold Inlet Block Assy**  
*PARTS LIST*

<b>Item</b>	<b>Part No.</b>	<b>Description</b>
1	2000019	Manifold Inlet Block Detail
2	2000031	Valve, Non-Return
3	2000037	Seal, Non-Return
4	9001746	Banjo 3/8 – 6mm Quad
5	9000038	Valve, Solenoid, 2-2 3/8BSP 24V DC
6	9000042	Washer, Sealing, 3/8BSP, Nylon
7	9000030	Straight, 1/4BSPMT 8mm OD Tube, PI
8	9001880	Blank, 1/4 BSPMP
9	9000041	Straight, 1/8BSPMT 6mm OD Tube, PI
10	9000032	Straight 1/4BSPMT, 3/8BSPMT
11	9000105	Straight 1/4BSPMT 6mm OD Tube, PI
12	9001874	Blank, 1/8BSPMP, Hex, Skt

**Manifold Outlet Block Assy**  
**GCU-400, Part No. 2024021**  
 Illustration No. 6000211



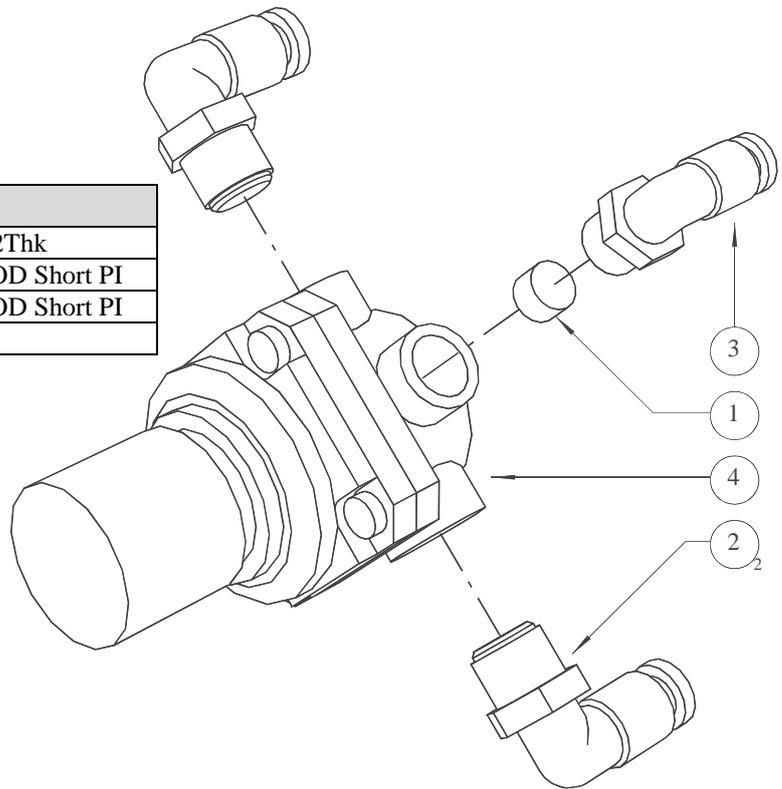
Item	Part No.	Description
1	2000018	Manifold Outlet Block
2	2000031	Valve, Non Return
3	2000037	Seal, Non Return Valve
4	9001045	Straight, 1/8BSP -6mm OD Tube Rapid, Metal I
5	9000041	Straight, 1/8BSPMP 6mm OD Tube PI
6	9000042	Washer, Sealing, 3/8BSP, Nylon
7	9000853	Washer, 1/8BSP Nylon, Red
8	9000854	Washer, 1/8BSP Nylon, Blue
9	9000855	Washer, 1/8BSP Nylon, Black

### Pressure Regulator Assy 4 Bar

**Part No. 2010018**

Illustration No. 6000091

Item	Part No.	Description
1	5000050	Disc Porous Plastic 8 x 3.2Thk
2	9000033	Elbow, 1/4BSPMT 6mm OD Short PI
3	9000062	Elbow, 1/8BSPMT 4mm OD Short PI
4	9000112	Pressure Regulator, 4 Bar

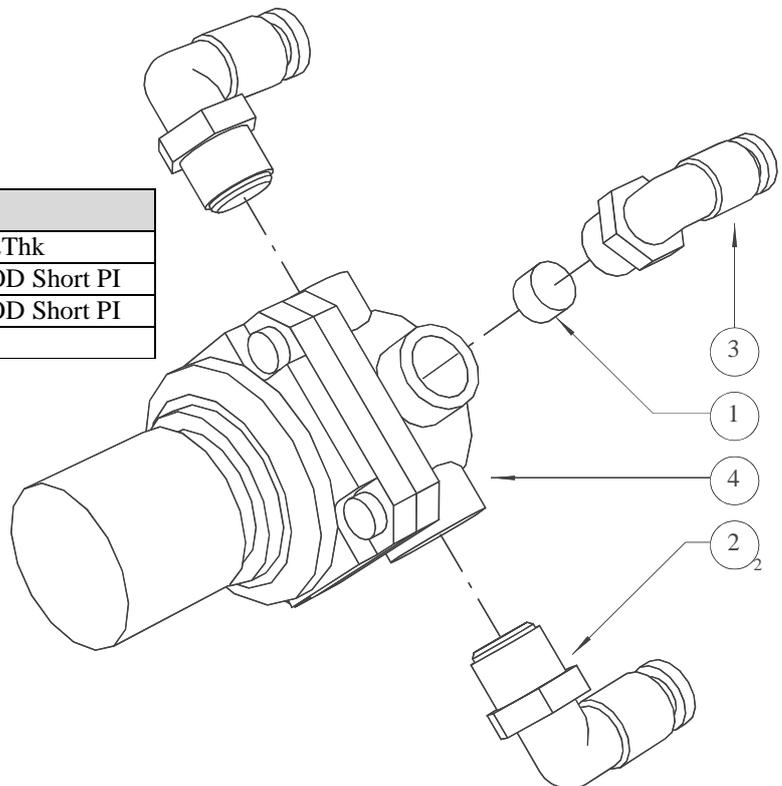


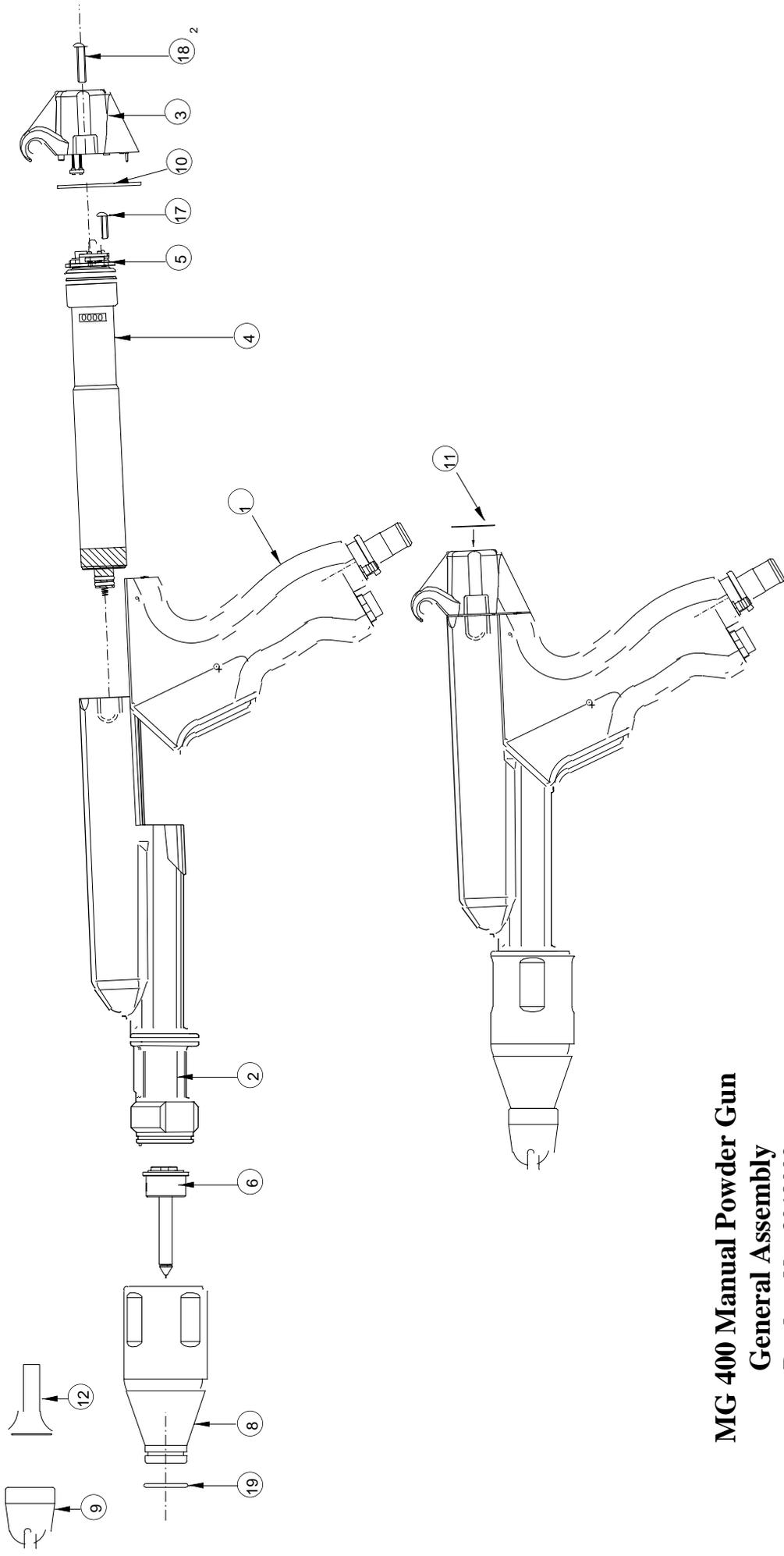
### Pressure Regulator Assy 2 Bar

**Part No. 2000026**

Illustration No. 6000090

Item	Part No.	Description
1	5000050	Disc Porous Plastic 8 x 3.2Thk
2	9000033	Elbow, 1/4BSPMT 6mm OD Short PI
3	9000062	Elbow, 1/8BSPMT 4mm OD Short PI
4	9000111	Pressure Regulator, 2 Bar



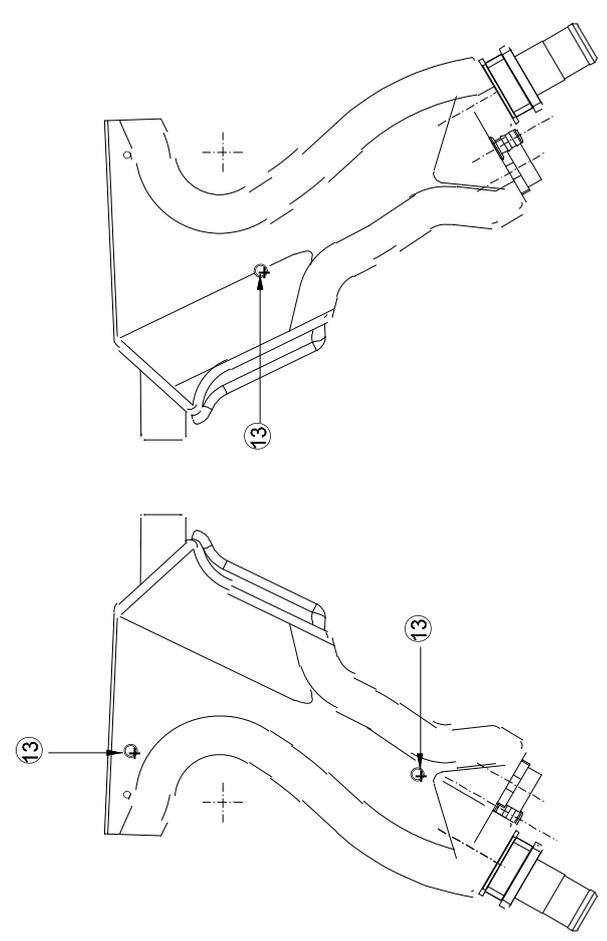
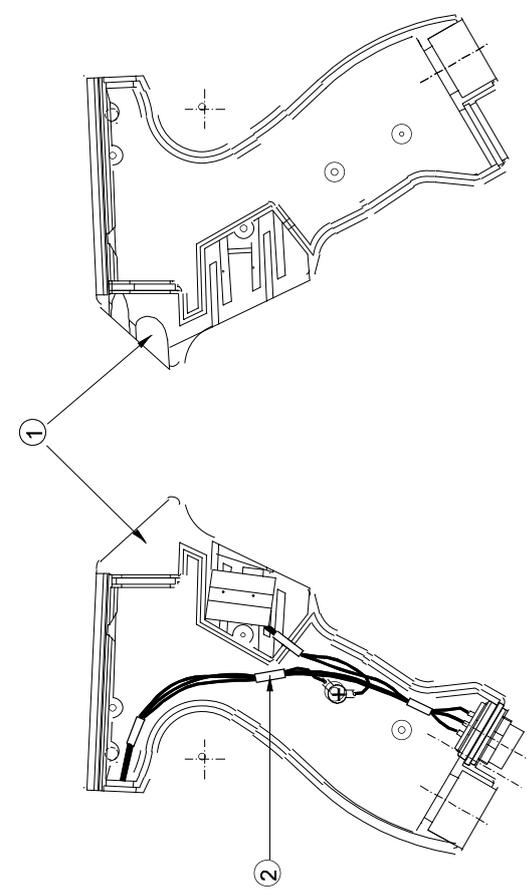
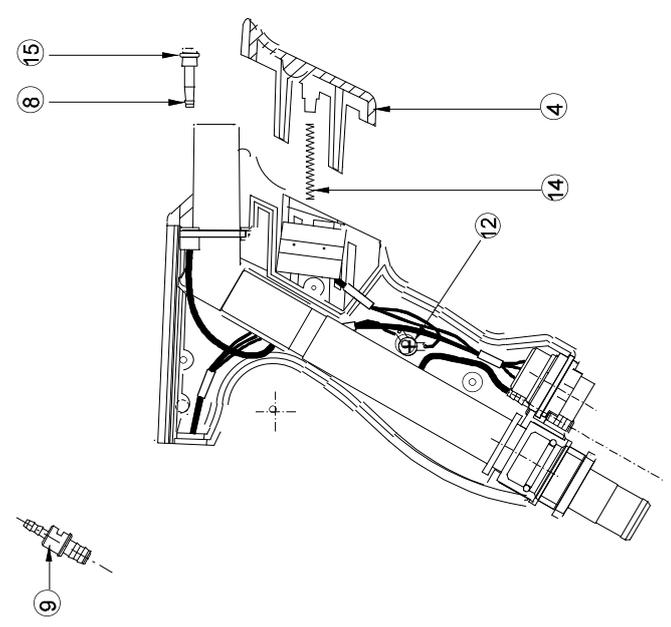
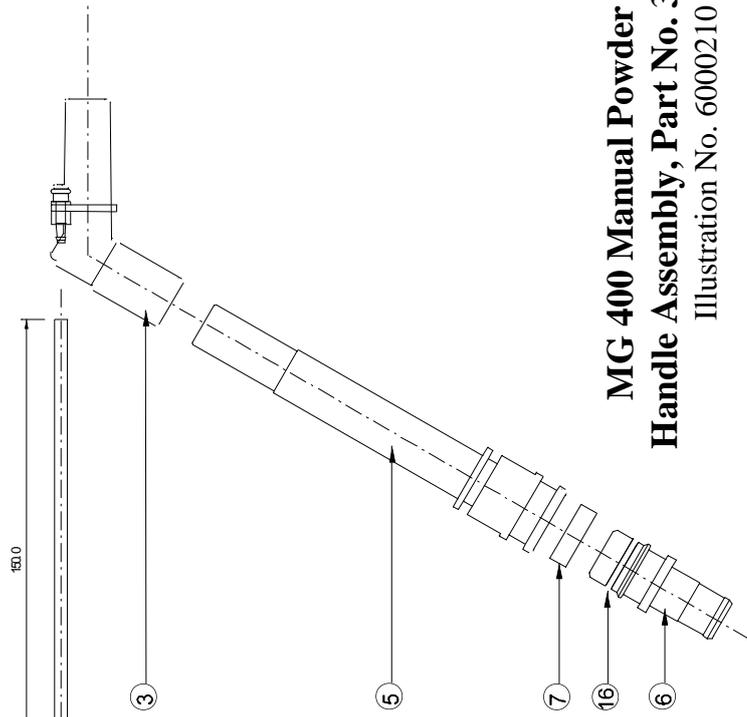


**MG 400 Manual Powder Gun**  
**General Assembly**  
**Product No: 3019002**  
**Illustration No: 6000209**

**MG 400 Manual Powder Gun General Assembly**  
*PARTS LIST*

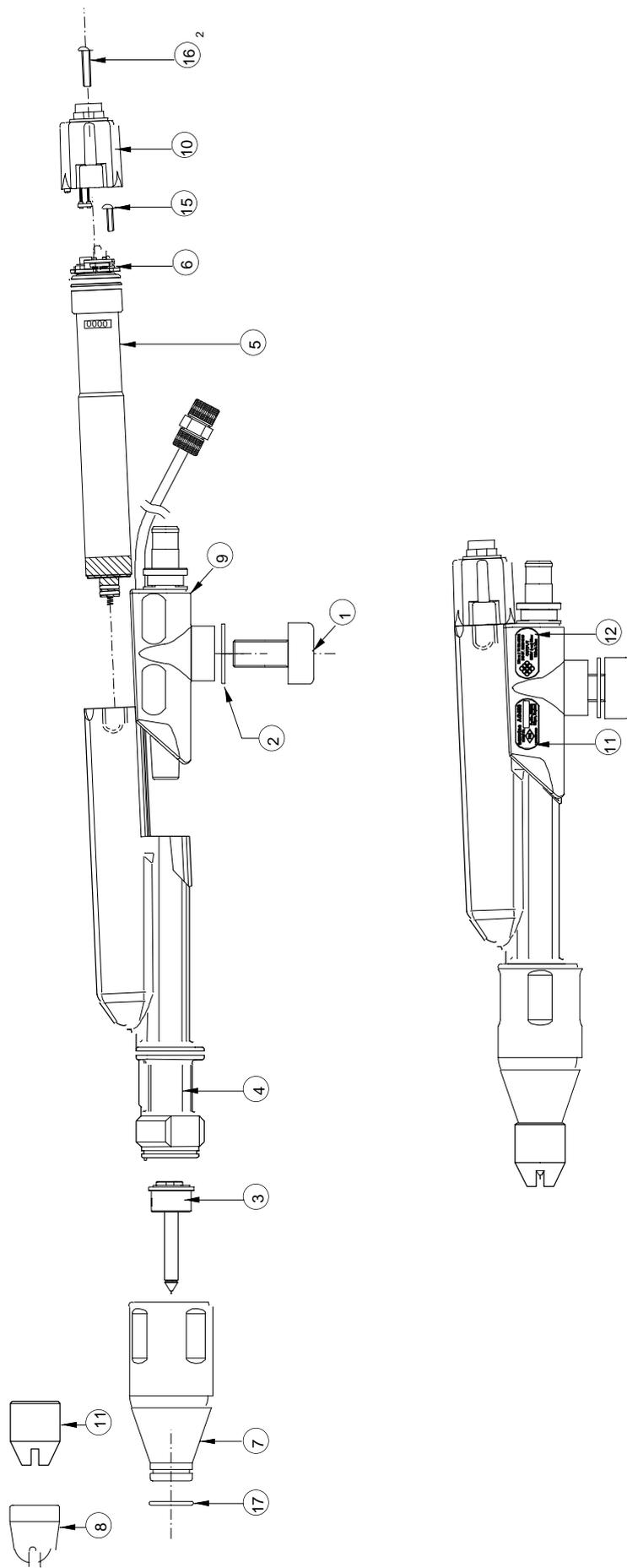
<b>Item</b>	<b>Part No.</b>	<b>Description</b>	<b>Qty.</b>
1	3019004	Handle Assy, MG400	1
2	3019005	Barrel Assy, AG/MG 400	1
3	3019006	Rear Cap Assy, MG 400	1
4	3019007	HV Multiplier Assy, AG/MG 400	1
5	3019008	Oscillator Assy, AG/MG 400	1
6	3016185	Electrode Assembly	1
7			
8	3019013	Nozzle Nut, AG/MG 400	1
9	3019017	Slotted Cap, AG/MG 400	1
10	3019020	Gasket, MG400	1
11	3019040	Label Rating, MG 400	1
12	3016201	Medium Stem Spreader	1
13			
14			
15			
16			
17	9000511	Screw, M3 x 12, Button Head Sems	1
18	9000578	Screw, M4 x 20 Hex, Skt, T/Proof, Pan HD	2
19	9001856	O-Ring, BS018, Silicone	1

**MG 400 Manual Powder Gun**  
**Handle Assembly, Part No. 3019004**  
 Illustration No. 6000210



**MG 400 Gun Handle Assembly**  
*PARTS LIST*

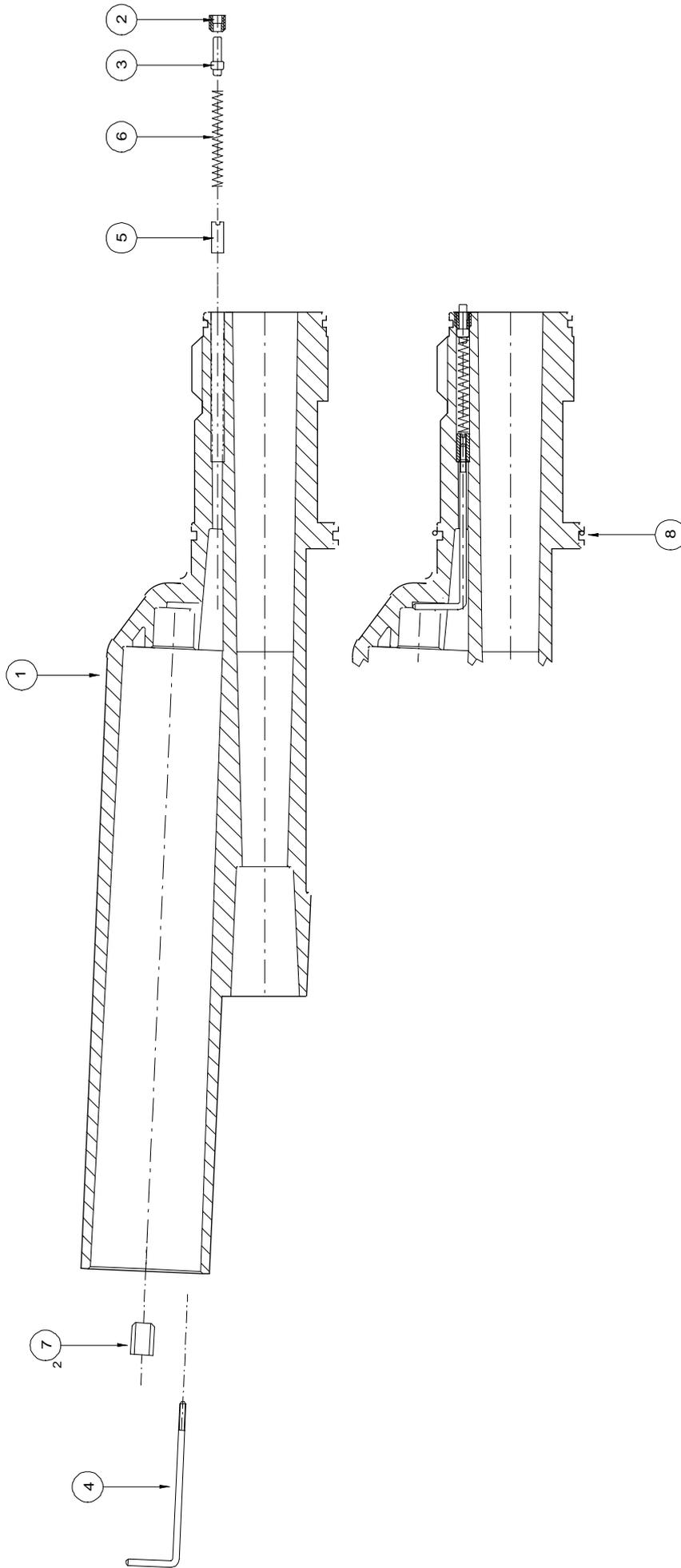
<b>Item</b>	<b>Part No.</b>	<b>Description</b>	<b>Qty.</b>
1	3019033	Handle, Sub Assy, MG 400	1
2	3019009	Wiring Assy, MG 400	1
3	3019011	Elbow, MG 400	1
4	3019012	Trigger, MG 400	1
5	3019024	Powder Tube, MG 400	1
6	3019025	Powder Tail, MG 400	1
7	3019026	Latch Ring, AG/MG 400	1
8	3019027	Air Connector, Barrel, AG/MG 400	1
9	3019028	Air Connector, Handle, MG 400	1
10			
11			
12	9000501	Screw, M3 x 6 Pan HD	1
13	9000513	Screw, M3 x 20 Pozi, HD	3
14	9001853	Spring, Compression, Trigger	2
15	9001860	O-Ring, 3 x 1 Silicone	1
16	9001863	O-Ring, 14 x 2 Silicone	1
17	9000203	Tubing, 4mm OD x 2.5mm ID, PU	0.15M



**AG 400 Automatic Powder Gun**  
**General Assembly, Part No. 3022002**  
 Illustration No. 6000196

**AG 400 Automatic Powder Gun General Assembly**  
*PARTS LIST*

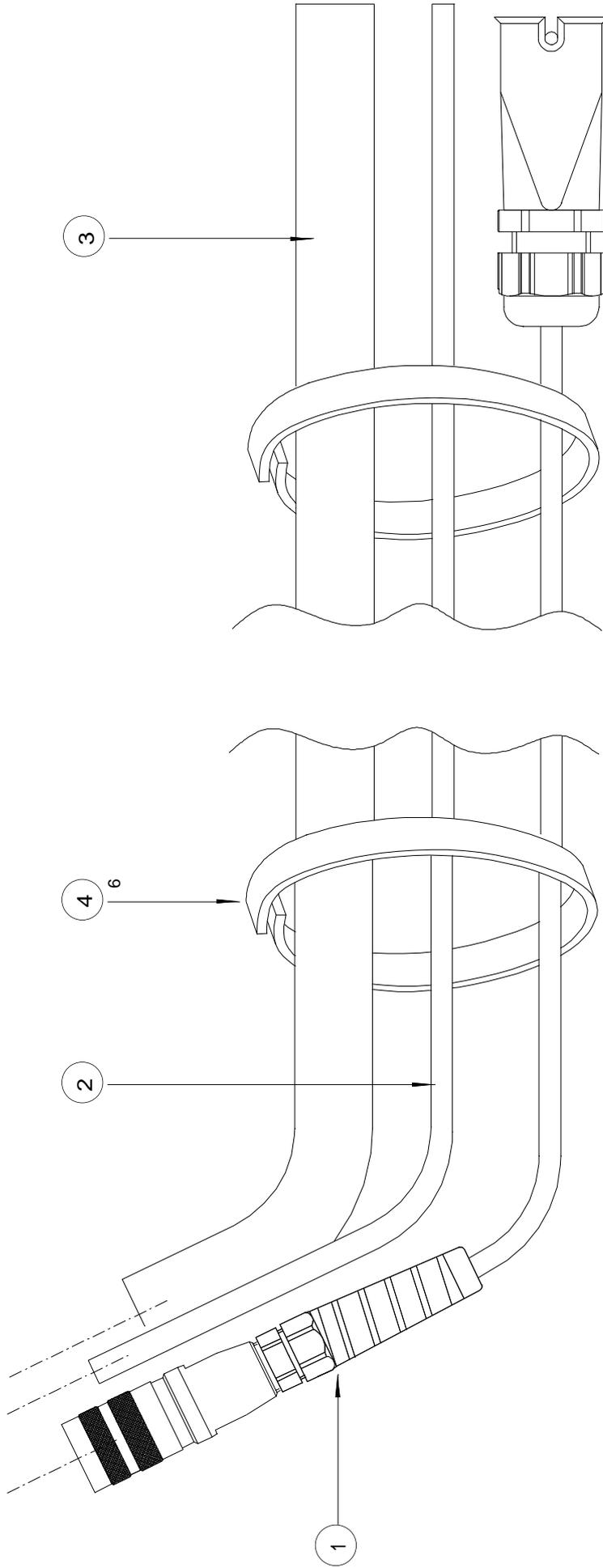
<b>Item</b>	<b>Part No.</b>	<b>Description</b>	<b>Qty.</b>
1	3001012	Gun Clamp Screw	1
2	3001014	Gun Clamp Washer	1
3	3016185	Electrode Assy	1
4	3019005	Barrel Assy, AG/MG 400	1
5	3019007	HV Multiplier Assy, AG/MG 400	1
6	3019008	Oscillator Assy, AG/MG 400	1
7	3019013	Nozzle Nut, AG/MG 400	1
8	3019017	Slotted Cap 6mm	1
9	3022004	Mounting Base Assy	1
10	3022006	Rear Cap Assy, AG400	1
11	3022017	Label, Serial No	1
12	3022018	Label, Rating	1
13	3022019	Slotted Cap 4mm, AG/MG 400	1
14			
15	9000511	Screw, M3 x 12, Pozi Pan Head Sems S/P	1
16	9000578	Screw, M4 x 20 Hex, Skt, T/Proof, Pan HD	2
17	9001856	O-Ring, BS018, Silicone	1



**AG/MG 400 Powder Guns**  
**Barrel Assembly, Part No. 3019005**  
 Illustration No. 6000199

Item	Part No.	Description	Qty
1.	3019010	Barrel, AG/MG 400	1
2.	3016013	HT Pin Retaining Screw	1
3.	3015024	HT Contact Pin	1
4.	3016038	HT Contact Rod	1
5.	3016039	HT Contact Nut	1
6.	9001852	Spring Compression,	1
7.	9001435	M4 Threaded Insert, Brass	2
8.	9001858	O-Ring, BS 026, Silicone	1





**5m Hose & Cable Set General Assembly**  
**Product No. 3019036**  
 Illustration No. 6000201

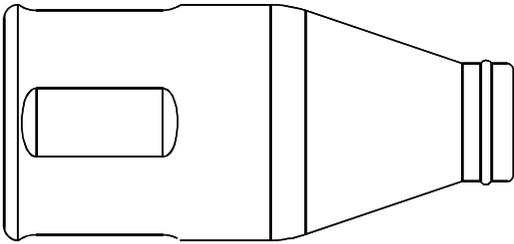
Item	Part No.	Description
1.	3016046	Cable Assembly
2.	9000084	Tubing, 6mm OD x 4mm ID, PU, Black
3.	9000081	Powder Hose Black
4.	9000256	Velcro, Double Sided



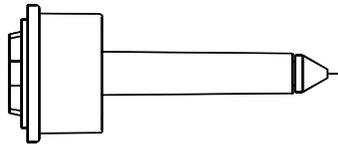
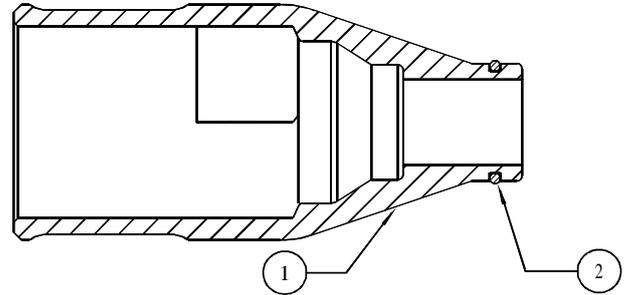
# Nozzle Components

## Automatic & Manual Powder Guns

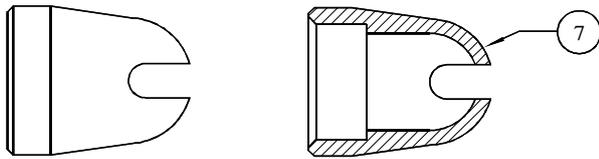
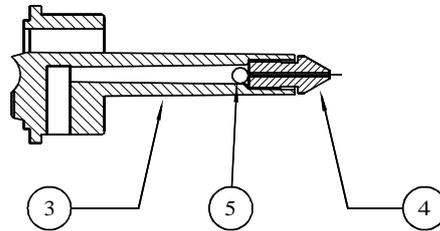
Illustration No. 6000202



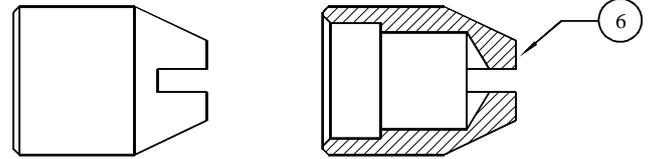
NOZZLE NUT, Pt. No. 3019013



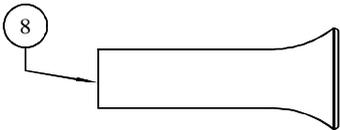
ELECTRODE ASSEMBLY Pt. No. 3016185



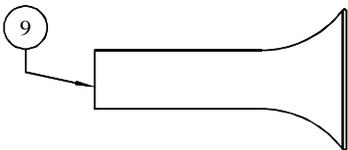
SLOTTED CAP - 6mm, Pt. No. 3019017



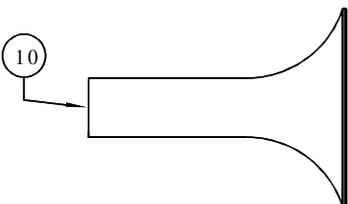
SLOTTED CAP - 4mm Pt. No. 3022019



STEM DEFLECTOR, SMALL Pt. No. 3016200



STEM DEFLECTOR, MEDIUM Pt. No. 3016201



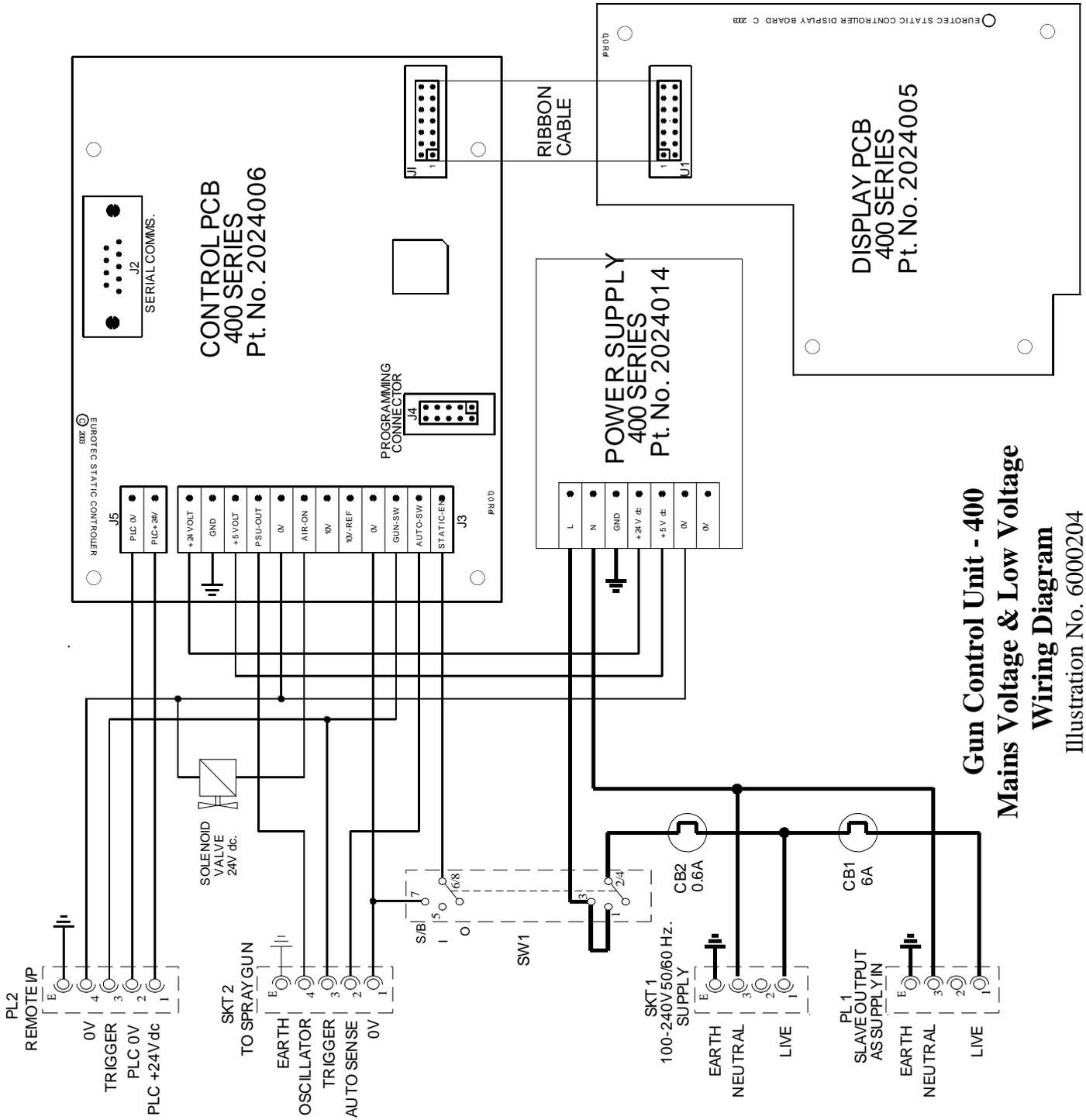
STEM DEFLECTOR, LARGE Pt. No. 3016202

Item	Part No.	Description
1	3019013	Nozzle Nut
2	9001856	O-Ring
3	3016158	Moulded Electrode
4	3016171	Electrode Support
5	3016172	Electrode
6	3022019	Slotted Cap - 4mm
7	3019017	Slotted Cap - 6mm
8	3016200	Deflector, Small
9	3016201	Deflector, Medium
10	3016202	Deflector, Large

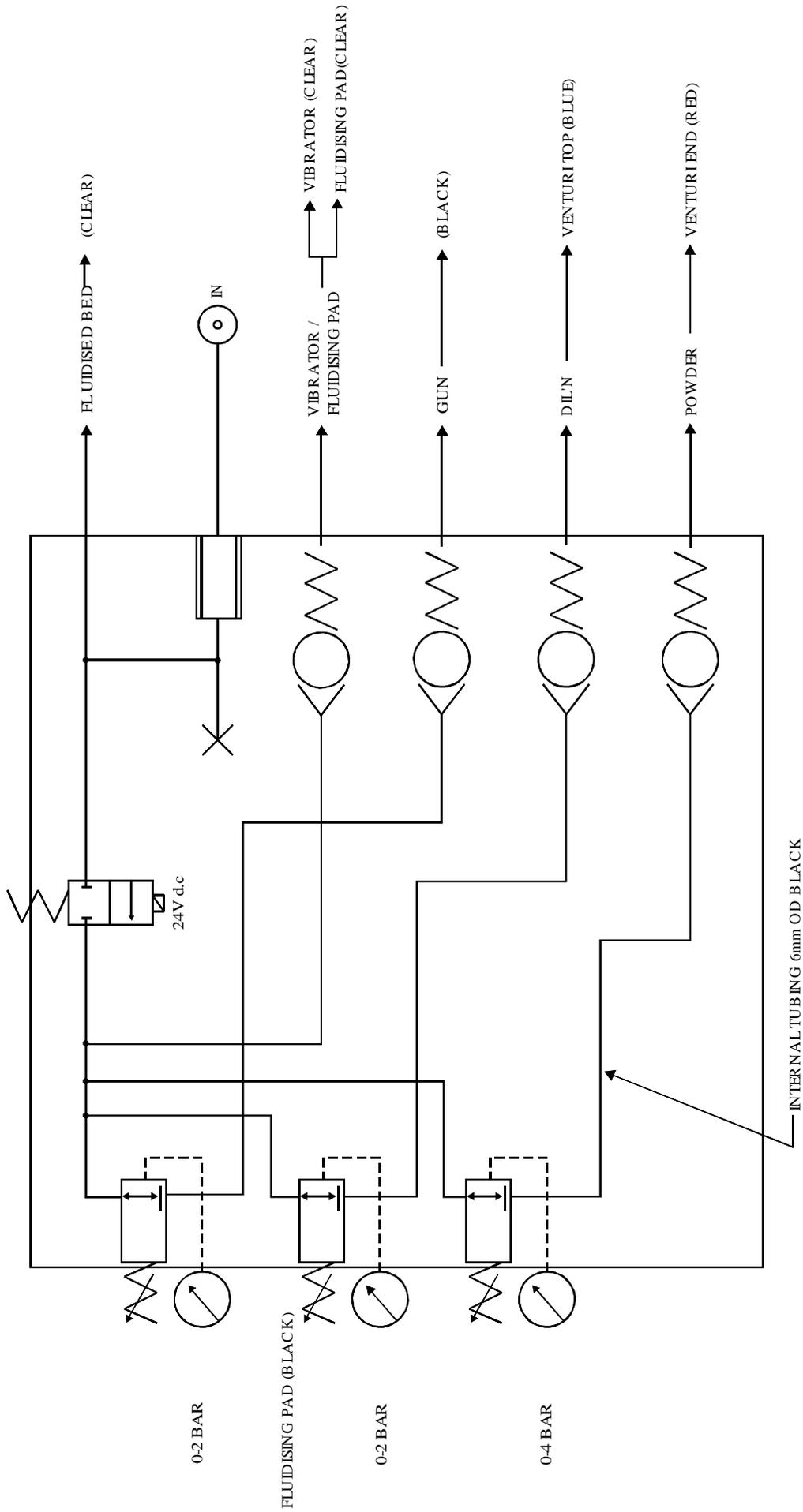


*APPENDIX (ii)*

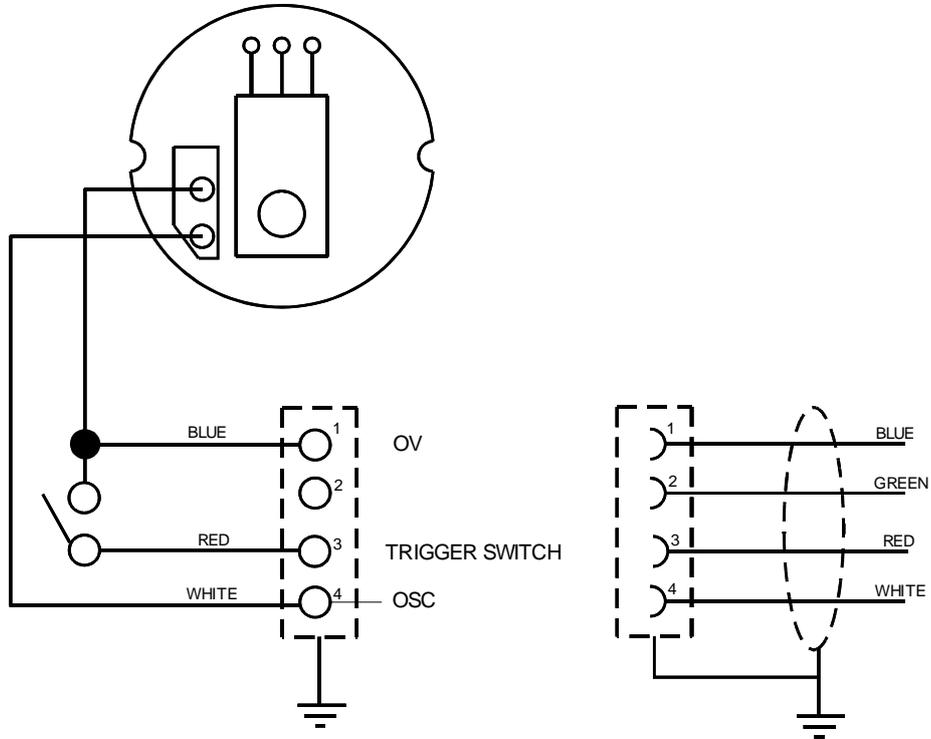
**SCHEMATIC DIAGRAMS**



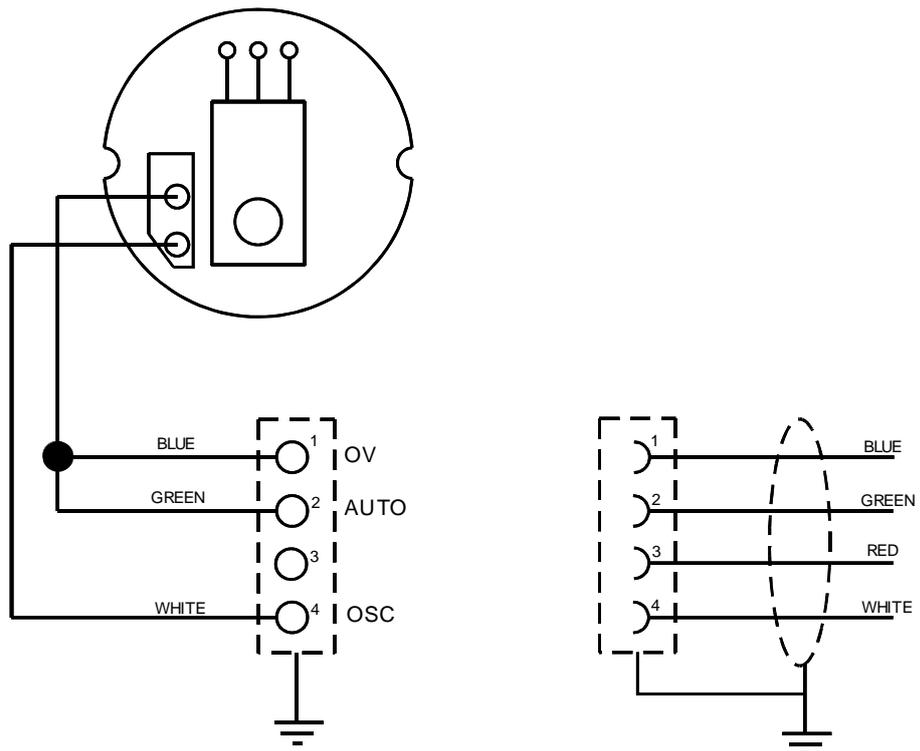
**Gun Control Unit 400**  
**Pneumatic Diagram**  
 Illustration No. 6000205



**Manual Powder Gun**  
**Wiring Diagram, Oscillator PCB**  
 Illustration No. 6000206



**Automatic Powder Gun**  
**Wiring Diagram, Oscillator PCB**  
 Illustration No. 6000207



*APPENDIX (iii)*

## **WARNING LABELS**



***NOTES:***